EVALUATION OF VARIABLE PUMPING RATES AS A MEANS TO REDUCE ENTRAINMENT MORTALITIES

John Young
William Dey
Steven Jinks

Martin Daley
John Carnright

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Compliance Requirement of Proposed Regulations

- Existing Station
- Tidal Estuary
  - Reduce Entrainment by 60%-90%

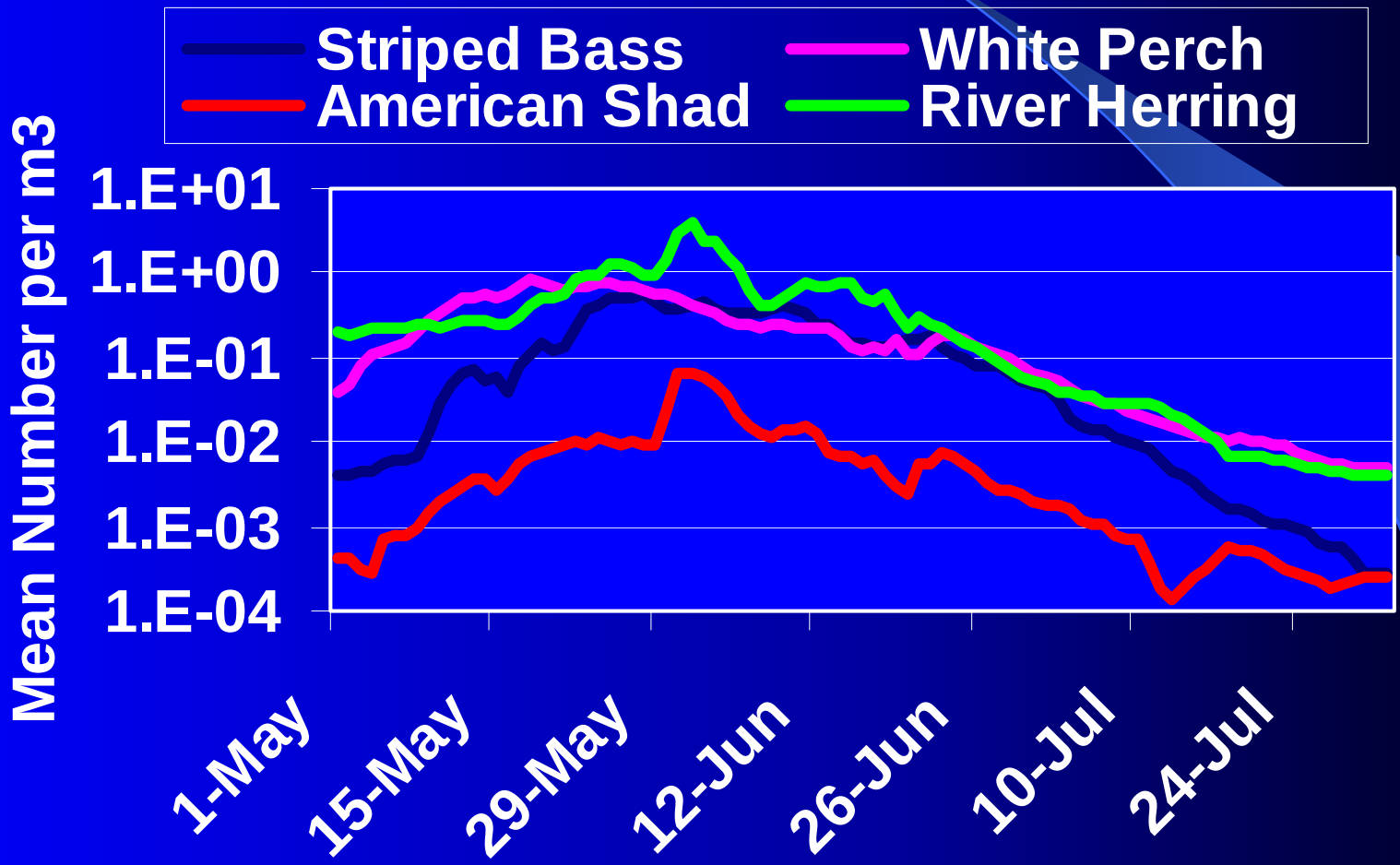
- Ancillary Issues
  - Calculation Baseline
  - Entrainment Survival

Roseton Generating Station

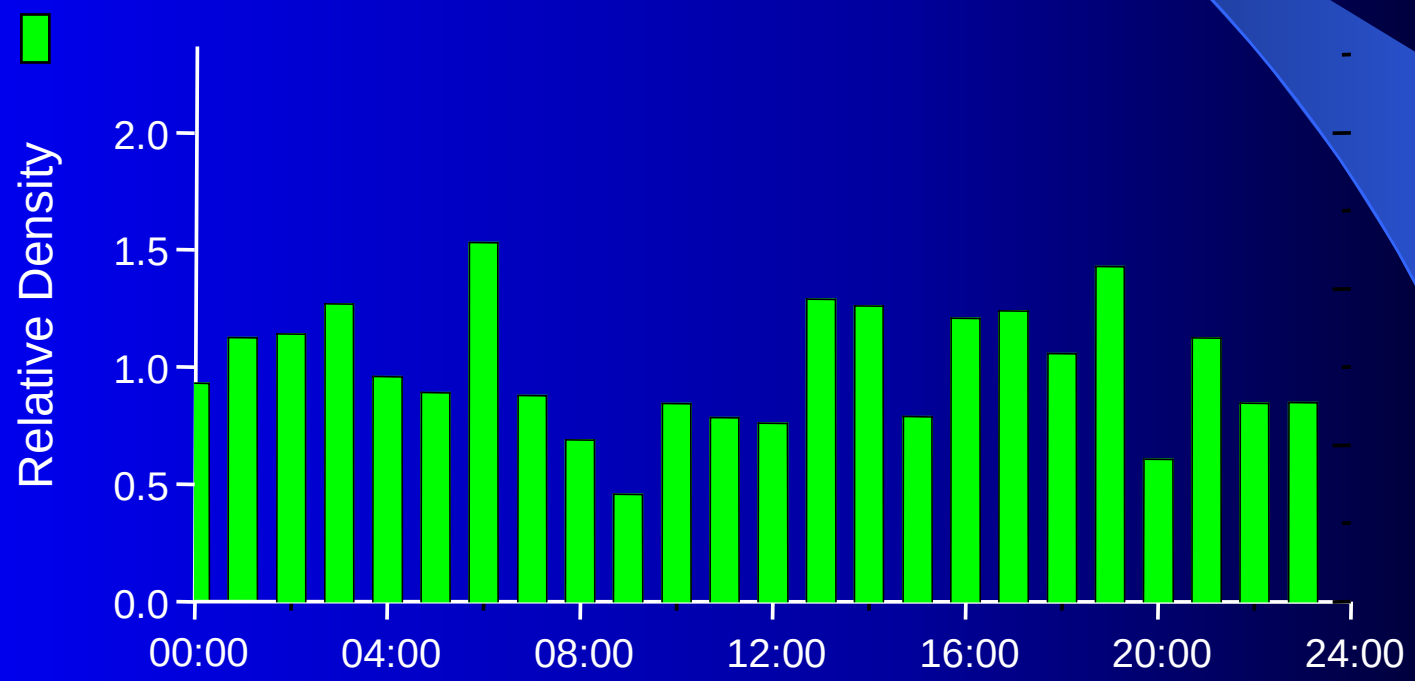
Information Available

- Entrainment Abundance Data
  - 1983-1987; May-July
  - 1-7 days/week, 24 1-hour samples
  - Pump samples from discharge
- Entrainment Survival Data
  - 1976-1980
  - Evolving gear and methods
- Plant Operation Patterns
  - 1999-2001, hourly
  - MW, Flows, Temperatures

Seasonal Pattern of Entrainment



Daily Pattern of Entrainment Striped Bass YSL



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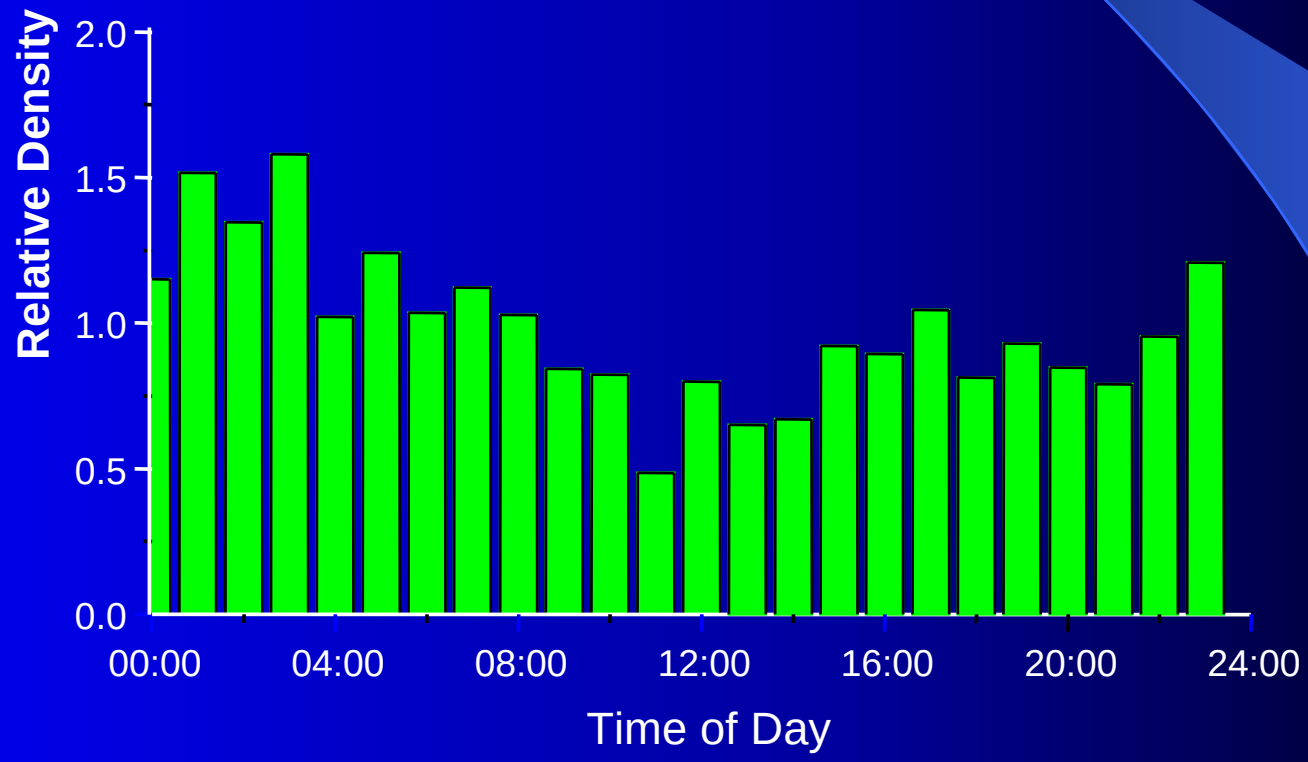
Daily Pattern of Entrainment
Striped Bass PYSL



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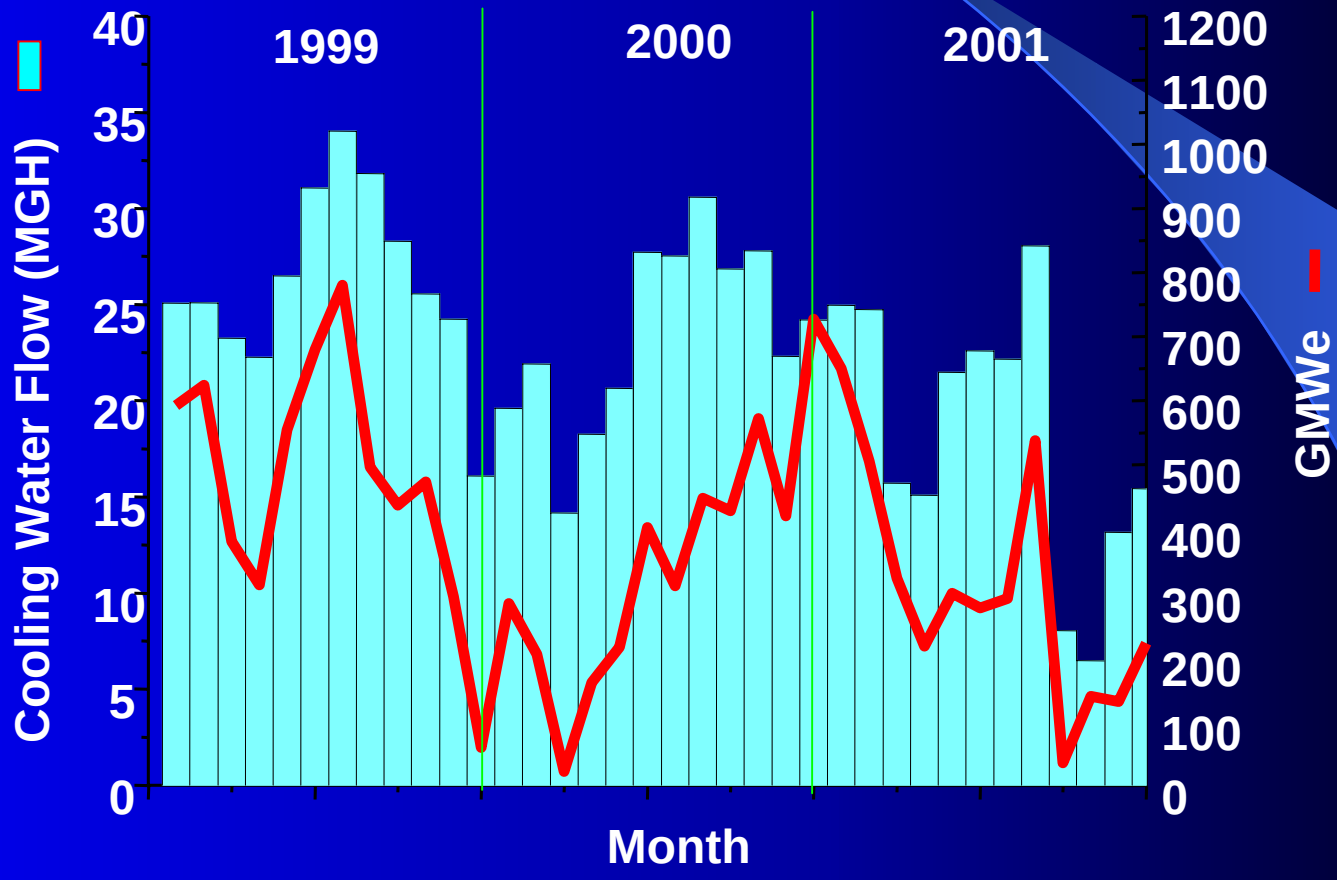
Annual Patterns of Flow and Generation



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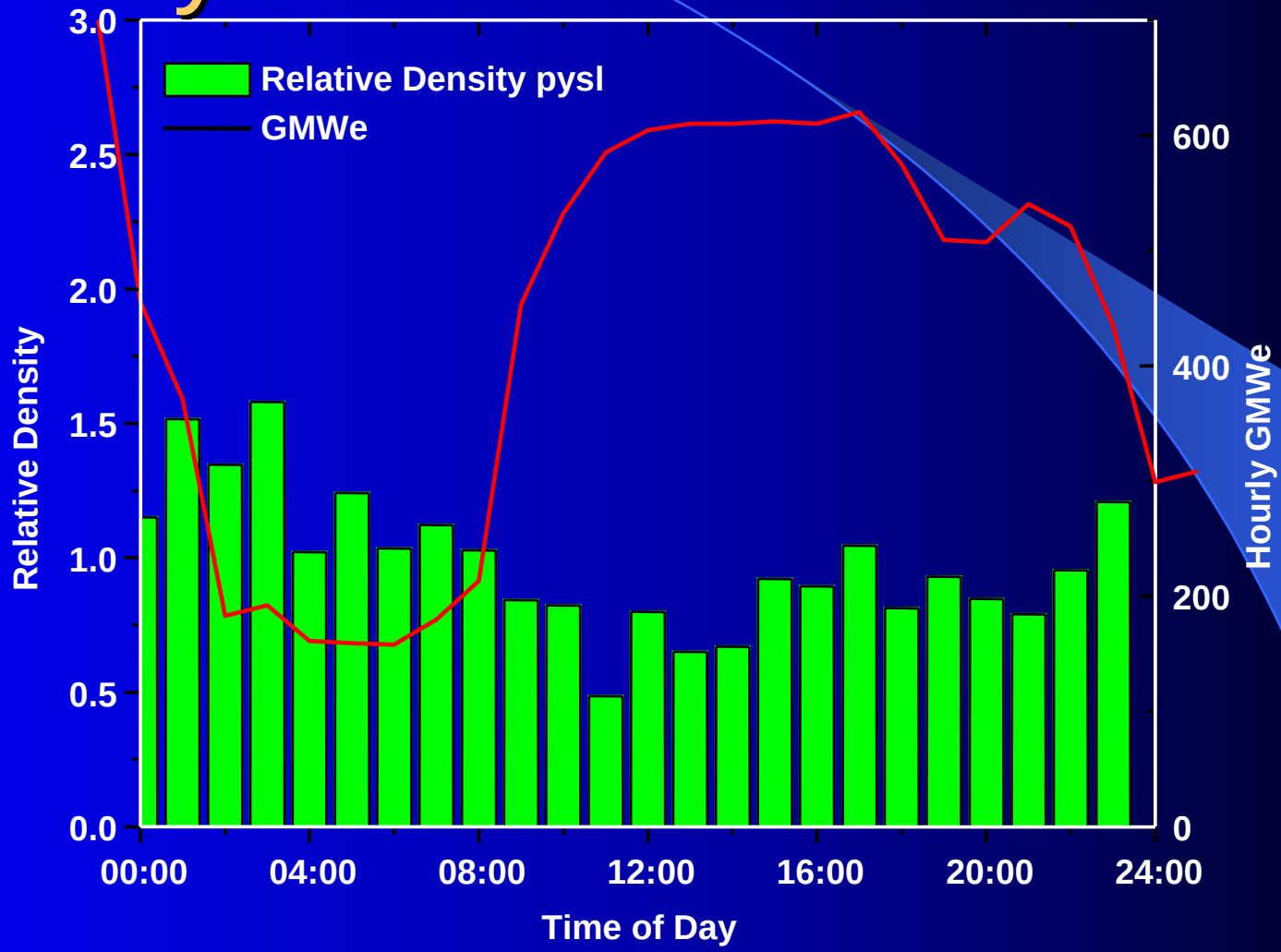
Daily Pattern of Generation



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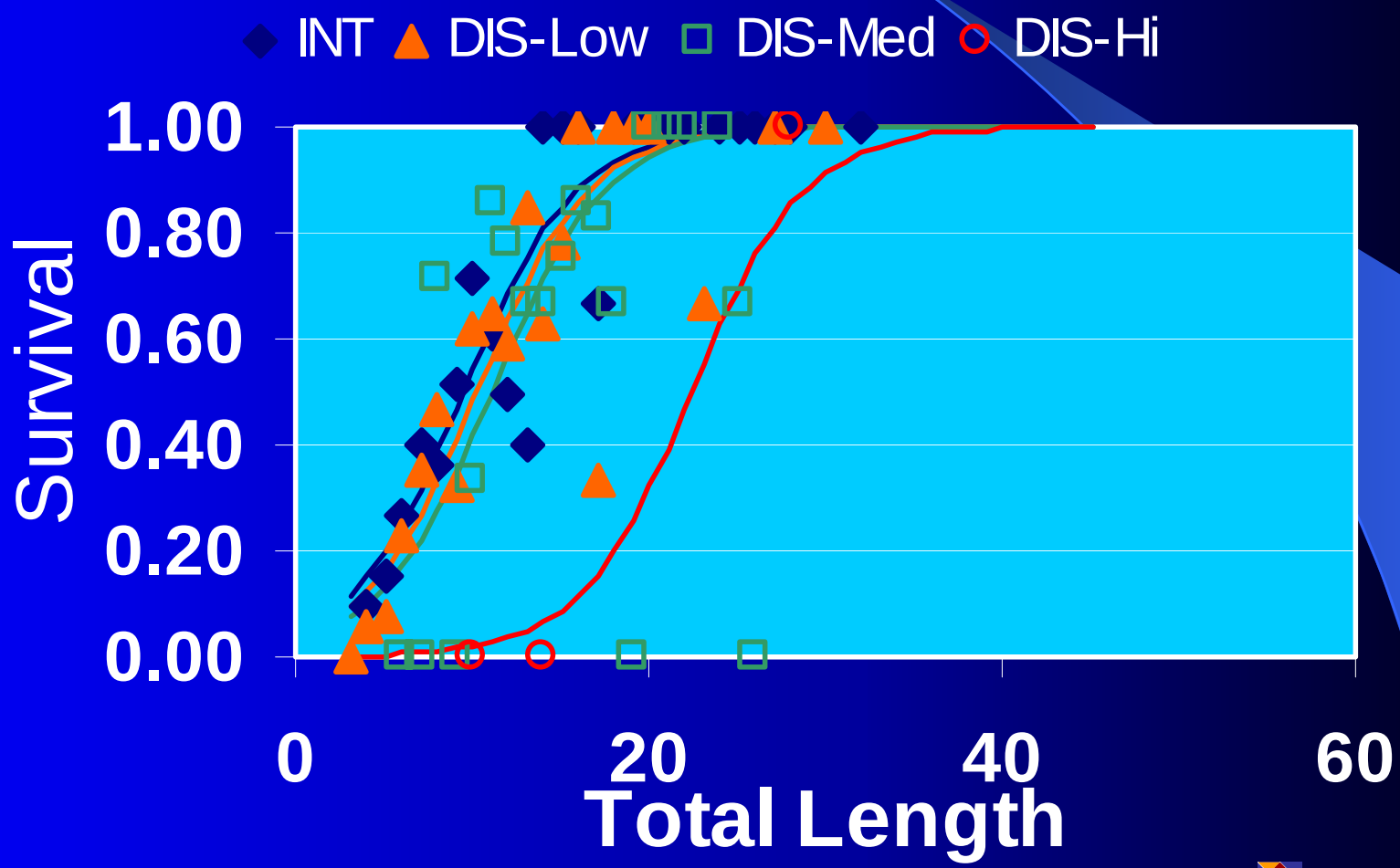
Entrainment Survival



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Strategy for Compliance: Match Flow to Generation on Hourly Time Scale

- Rapid response of plant operations to varying generation
- Capability for fine-scale flow control
  - Pump On-off
  - Variable-speed pumps
- Operational rules
  - Minimum flows
  - Maximum discharge temperatures
  - Maximum ΔT

Operating Rules

- Use minimum flow necessary to
  - Discharge temperature below target: 20-40C
  - ΔT below maximum: 15-30C
  - Flow at or above set minimum: 34% of Full
- If target discharge temperature exceeded
  - ΔT below maximum

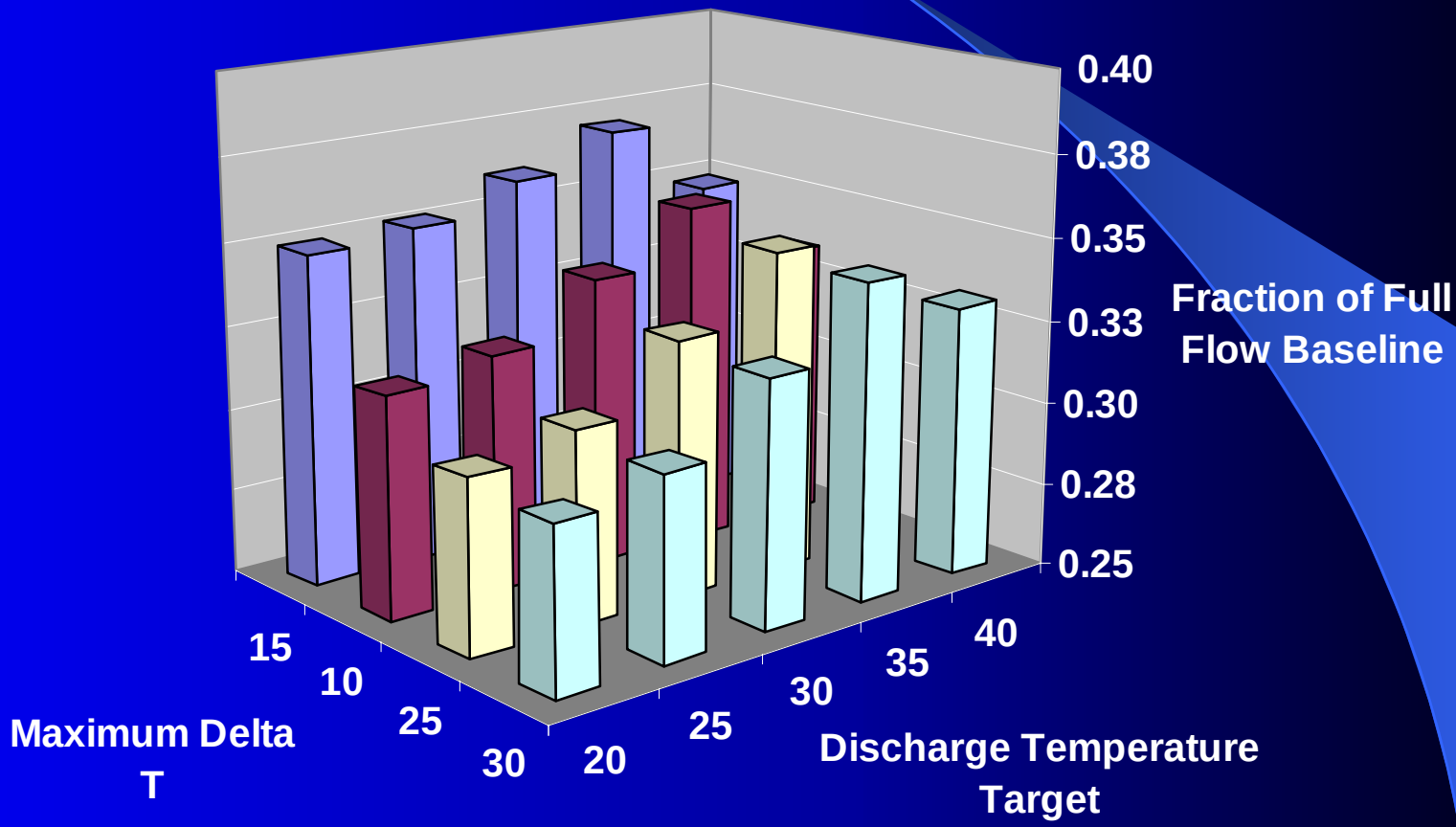
Calculation Baseline

- Initial EPA Proposal
  - Full flow year-round
  - Full operation
  - 100% Mortality
- NODA
  - Past operational practices
    - Seasonally reduced flows
  - 100% Mortality

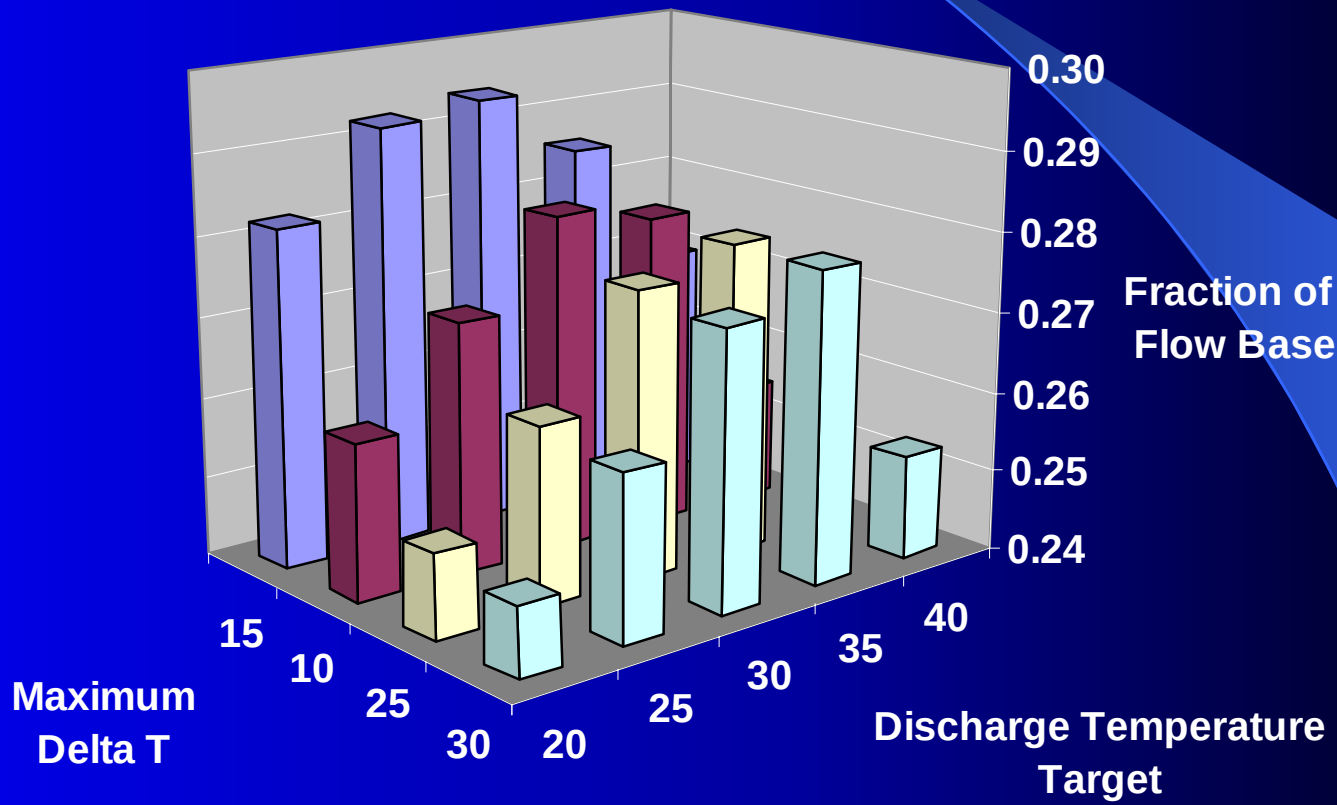
Analysis Process

- Define hourly Flow and Discharge Temp
  - Historical generation, ambient temperature
  - Operating rules
- Determine numbers entrained
  - Flow and historical density pattern
- Determine numbers killed
  - Size, mechanical and thermal mortality
- Compare annual total numbers to baseline

Reduction in Flow



Reduction of Number Entrained



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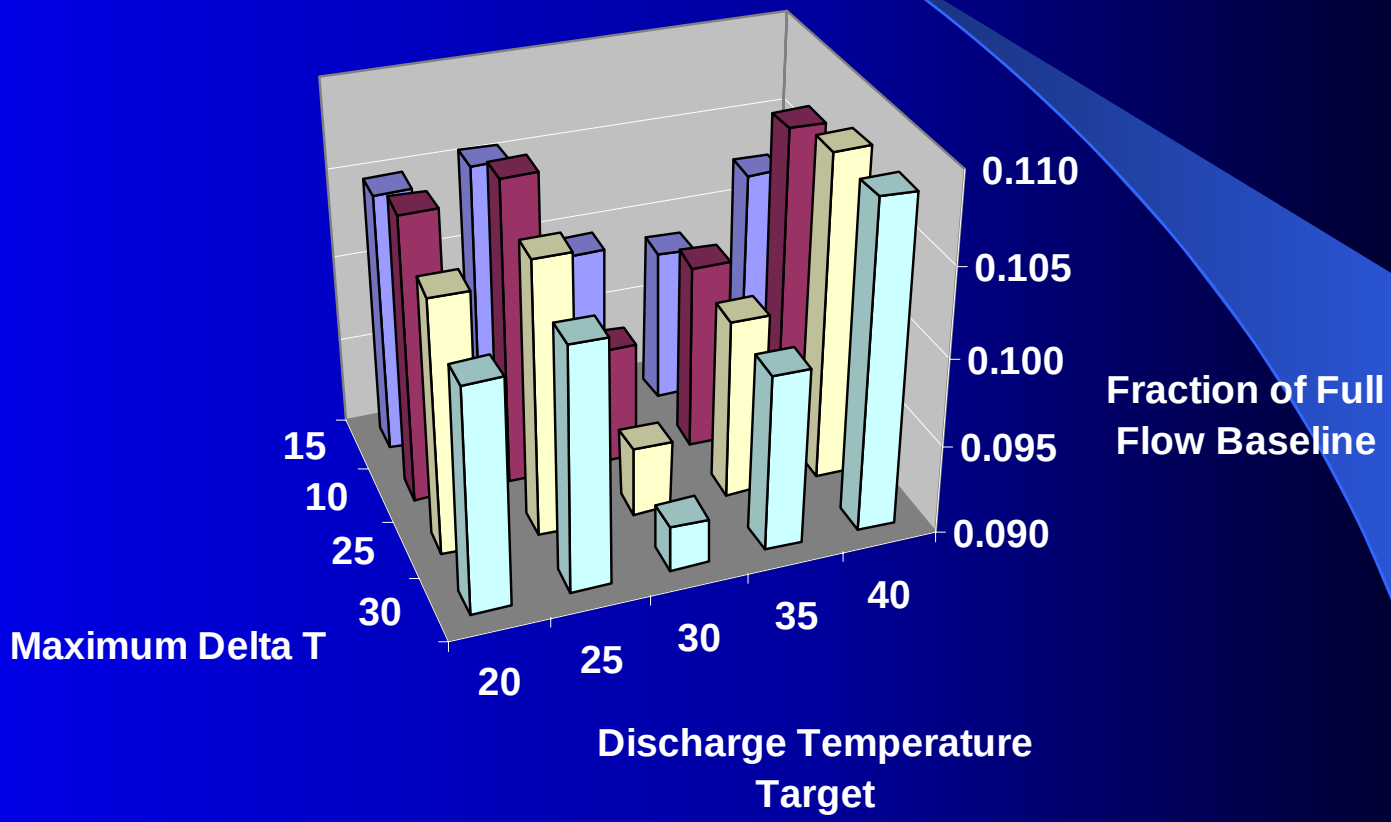
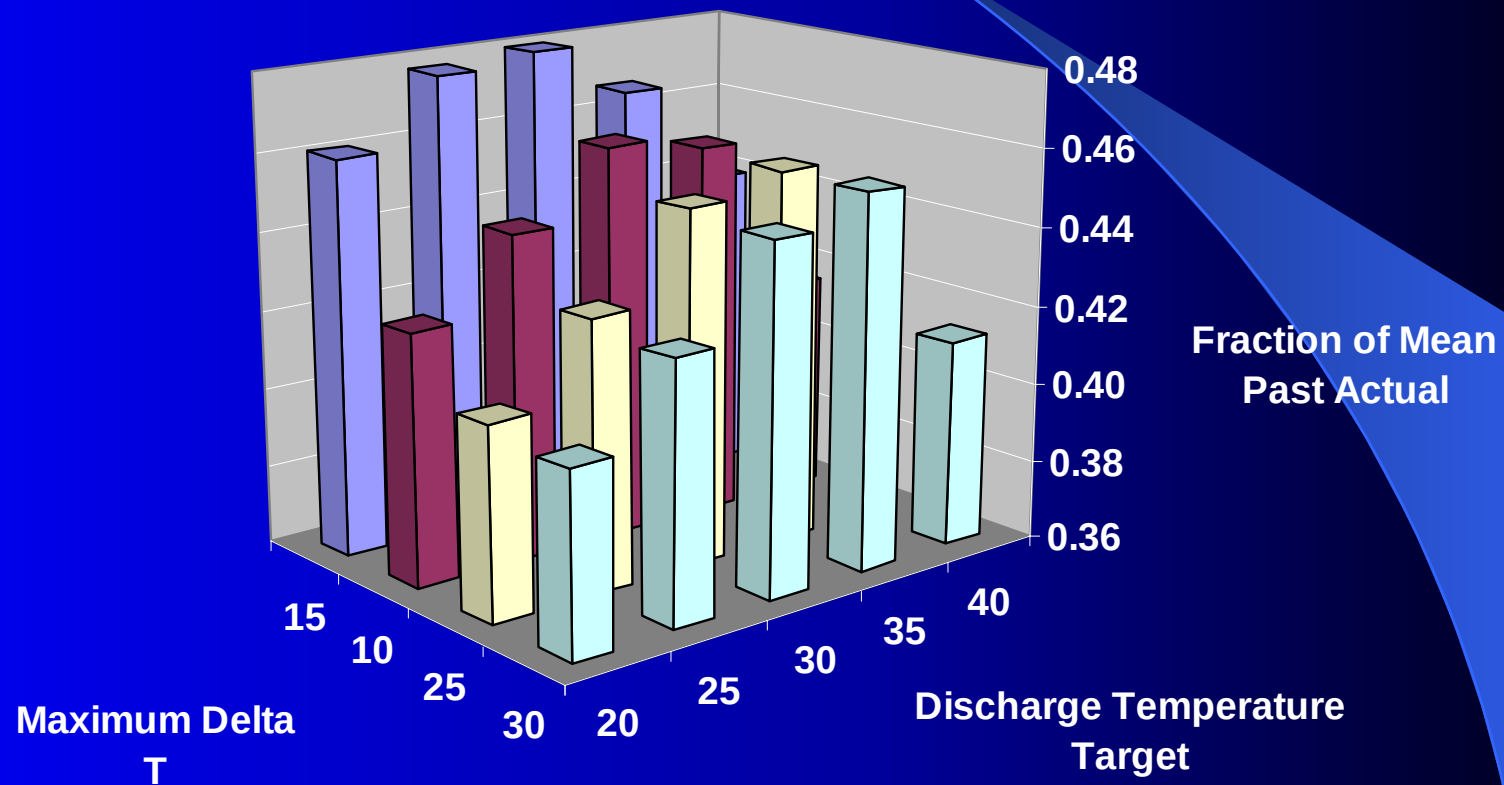
Reduction in Number Killed



Effect of Alternate Baseline Number Entrained



Conclusions

- Variable pumping rates can achieve significant entrainment reductions
  - Peaking plants
  - Diel abundance pattern counter to generation
  - Hardy species with demonstrable survival
- Wide range of Operating rules
  - Performance analysis necessary
  - Compliance of discharge with thermal criteria
- Critical Issues
  - Definition of Baseline
  - Entrainment Survival